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Leibniz, as the second discoverer of the calculus, "has borrowed from Newton," while on page 9 Child says, "Fatio does not dare to make a direct assertion, only an insinuation."

Some of the footnotes contain conjectures relating to historical events and the motives which prompted the movements of the actors. These conjectures are of value, provided the rapid reader does not lose sight of the fact that they are only conjectures. Indeed, some of Child's contentions are far from convincing. Take the matter of the "Characteristic triangle." Leibniz used it but does not claim it as his own. He says he got it from Pascal. Child argues that Leibniz must have gotten it from Barrow, on the ground that Leibniz obtained a copy of Barrow's *Lectiones Opticæ et Geometricæ* a month or so before he got a copy of Pascal, and that Leibniz's geometrical figure more closely resembles Barrow's than that of Pascal. Child may be correct in his view that for geometrical knowledge, Leibniz was indebted to Barrow more deeply than is ordinarily believed.

As regards the Newton-Leibniz controversy, Child agrees with A. De Morgan in characterizing the publication of the *Commercium epistolicum* by the Royal Society of London as an act of disgraceful unfairness; Child discards the hypothesis that Leibniz took his calculus from Newton, and says: (p. 5) "I hold quite other views as to the possible source of Leibniz's inspiration, if indeed he is not to be credited with perfectly independent discovery."

There are a few American reviewers who unconsciously have acquired the mannerism of belittling American contributions to the history of science and extolling foreign ones. While in the past, the present reviewer may have exhibited an exactly opposite tendency, he has no hesitation in this case to express the opinion that students of the history of mathematics will feel greatly indebted to Child for his translations and for his conscientious, fair-minded and thorough study of the documents involved.

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Infinitesimal Calculus. By F. S. CAREY. (Longmans Mathematical Series.) London, Longmans, 1919. 8vo. 20 + 352 + 9 pages. Price 14 shillings.

How far should one go in introducing new ideas at the beginning of a first course in the calculus? And how much time can one afford to spend in explaining those ideas? It is in answering these two questions that the text before us differs most radically from our standard texts. Most writers seem to agree that while in an introductory course the notions of variable, function and limit must be discussed, a very brief discussion is best, introducing as little notation and as few new terms as possible, with the thought presumably that those notions will become most rapidly and truly understood through use.

The attitude of the author is given in the preface. "Believing that there is no royal road which leads smoothly and directly to the Infinitesimal Calculus, the author has made no attempt to evade all the difficulties which at the outset face the student in this subject. The road has, however, been laid in the first section so as to pass through those domains of number and function with which the student is probably already acquainted. . . . To assist the student in mastering the fundamental conception of a differential coefficient, two ideas which are usually reserved for books of a more advanced character have been introduced at the beginning and used throughout the book, namely, range and sequence, and the ordinary symbolism in connection with them has been varied. . . . The book . . . is essentially a book of practical mathematics. With this end in view, fundamental ideas are explained at great length; for the easiest and quickest way to master this subject is to acquire a firm grasp of the conceptions upon which it is based. The student is advised to return again and again to the earlier chapters; it is only gradually that the matter contained in them can be assimilated. . . "

In accord with these statements the author has taken more than twice as much time for his introductory material as is common in other introductory texts, and the notions range and sequence are brought into unusual prominence. Most of us will, I believe, doubt the necessity, and hence the desirability also, of directing so much energy toward the mastery of these concepts so early in the student's career. But if we accept the author's point of view, and do not try to quarrel with him over what should be the purpose of his book, we must compliment him upon the skill with which he has carried out his plan. Anyone agreeing with his point of view will be delighted with his full and elementary presentation.

The symbolism referred to for range and sequence is simple and worthy of mention. An open range from a to b is denoted by brackets $[a, b]$, a closed range by parentheses (a, b); and a range open only at one end by the appropriate combination of the bracket and parenthesis symbols; thus a range open at a and closed at b is denoted by $[a, b)$. If a variable x ranges over a sequence having a limit a, one finds the general notation $x \rightarrow a$; if the sequence is monotone non-decreasing the notation is $x \rightharpoondown a$, if monotone non-increasing $x \rightharpoonup a$. This variation of the arrow notation seems especially simple and suggestive.

The book contains a number of variations from what we are accustomed to, which are interesting. One example is the general use of the symbol D^{-1} for the inverse of differentiation until after a discussion of definite integrals. There will be differences of opinion as to the desirability of delaying the use of the ordinary integral sign in this way. To me it seems best to associate thus D and D^{-1} as operator and inverse, and to have the integral sign presented with the idea of an integral as the limit of a sum. I believe the student will more quickly obtain a correct idea of definite integrals, which is of course a consideration of prime importance, while D^{-1} appears as a more natural notation for the inverse of differentiation.

Another variation from custom is the omission of Duhamel's theorem or any theorem resembling it. Problems which may be solved by the use of simple definite integrals are put into the form of differential equations with initial conditions, without, however, using this terminology. The method is simpler.

I think, than to use Duhamel's theorem, and as logical. It should be added, however, that in the treatment of multiple integrals the author is not so successful, and is forced to disregard small quantities of higher order without explanation.

The American reader is impressed with the amount of geometry that is given. The chapters on curve tracing, envelopes, evolutes, roulettes, and graphics and nomography have much in them that is not included in our introductory texts. As there are no counterbalancing omissions, we would find it necessary to lengthen our course to include it all. The book furnishes an excellent reference work for this material. The last chapter, on "Graphics, nomography," gives in ten pages a good idea of the possibilities of the subject, and should, as the author states, "enable the reader to follow the complicated nomograms which are largely used in France and other countries."

The book as a whole is very carefully written, with surprisingly few errors. An occasional slip is however noted. For example, on page 49, we read that "if $f(x)$ is increasing as x passes through $x = a$, $f'(a)$ is positive," overlooking the possibility of $f'(a) = 0$. Other errors were noted, but are of no great importance.

E. J. MOULTON.

Periodic Orbits. By F. R. MOULTON in collaboration with DANIEL BUCHANAN, THOMAS BUCK, F. L. GRIFFIN, W. R. LONGLEY, W. D. MACMILLAN. (Publication no. 161) Carnegie Institution of Washington, 1920. 4to. 14 + 524 pp.

Quotation from the Introduction: "The problem of three bodies received a great impetus in 1878, when Hill published his celebrated researches upon the lunar theory. His investigations were carried out with practical objects in mind, and comparatively little attention was given to the underlying logic of the processes which he invented. For example, the legitimacy of the use of infinite determinants was assumed, the validity of the solution of infinite systems of non-linear equations was not questioned, and the conditions for the convergence of the infinite series which he used were stated to be quite unknown. These deficiencies in the logic of his work do not detract from the brilliancy and value of his ideas, and his skill in carrying them out excites only the highest admiration.

"The work of Hill was followed in the early nineties by the epoch-making researches of Poincaré, which were published in detail in his *Les Méthodes Nouvelles de la Mécanique Céleste.* Poincaré brought to bear on the problem all the resources of modern analysis. The new methods of treating the difficult problem of three bodies which he invented (*sic*) were so numerous and powerful as to be positively bewildering. They opened so many new fields that a generation will be required for their complete exploration. On the one hand, the results were in the direction of purely theoretical considerations, in which Birkhoff has recently made noteworthy extensions; on the other hand, they foreshadowed somewhat dimly methods which will doubtless be of great importance in practical applications in celestial mechanics. The researches of Poincaré are scarcely less revolutionary in character than were those of Newton when he discovered the law of gravitation and laid the foundations of celestial mechanics.

"In 1896 Sir George Darwin published an extensive paper on the problem of three bodies in *Acta Mathematica.* In mathematical spirit it was similar to the work of Hill; indeed, the methods used were essentially those of Hill, but the problem treated was considerably different. For a ratio of the finite masses of ten to one, Darwin undertook to discover by numerical processes all the periodic orbits of certain types and to follow their changes with varying values of the Jacobian constant of integration. This program was excellently carried out at the cost of a great amount of labor. It gave specific numerical results for many orbits in a particular example.

"The investigations contained in this volume were begun in 1900 and, with the exception of